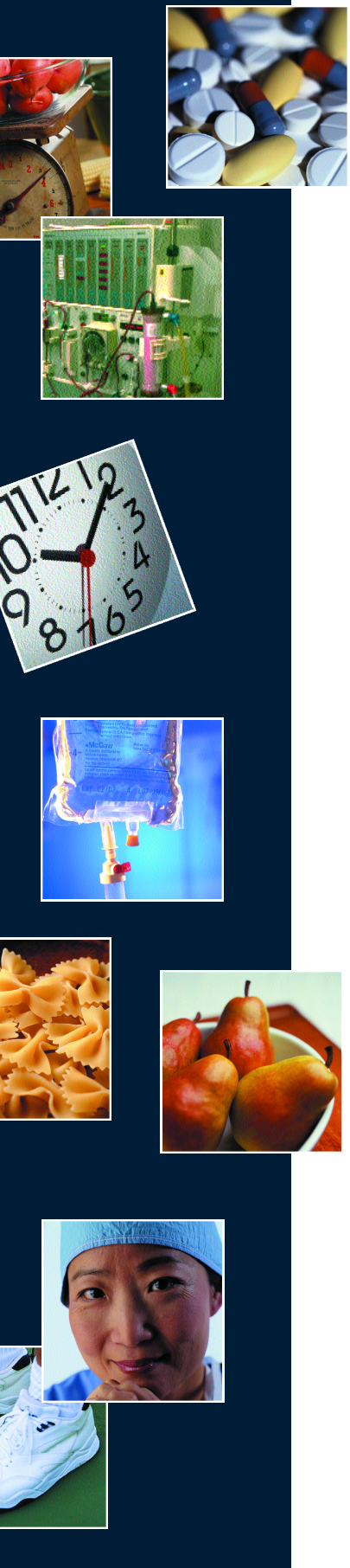
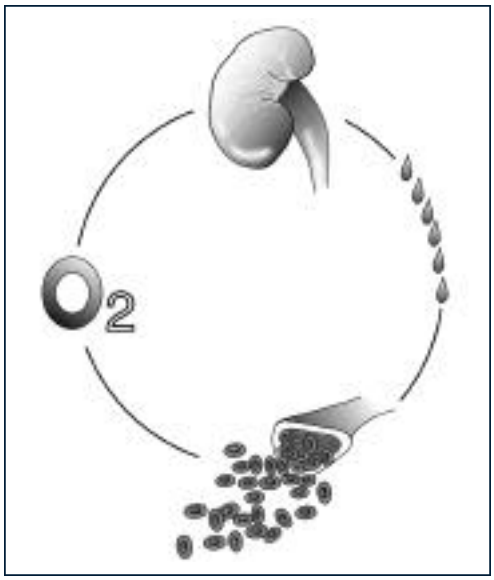


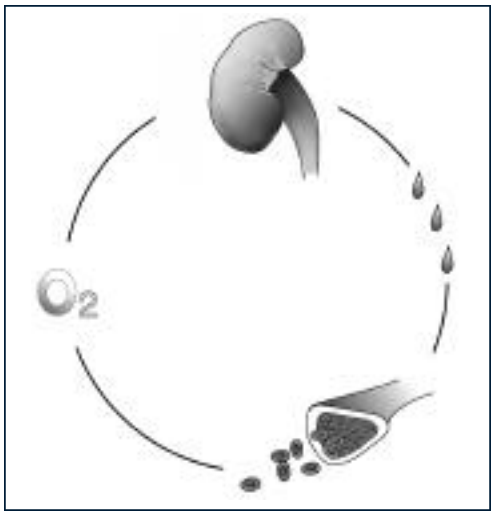
Anemia in Kidney Disease and Dialysis

If your blood is low in red blood cells, you have anemia. Red blood cells carry oxygen (O_2) to tissues and organs throughout your body and enable them to use the energy from food. Without oxygen, these tissues and organs—particularly the heart and brain—may not do their jobs as well as they should. For this reason, if you have anemia, you may tire easily and look pale. Anemia may also contribute to heart problems.

Anemia is common in people with kidney disease. Healthy kidneys produce a hormone called erythropoietin, or EPO, which stimulates the bone marrow to produce the proper number of red blood cells needed to carry oxygen to vital organs. Diseased kidneys, however, often don't make enough EPO. As a result, the bone marrow makes fewer red blood cells. Other common causes of anemia include loss of blood from hemodialysis and low levels of iron and folic acid. These nutrients from food help young red blood cells make hemoglobin (Hgb), their main oxygen-carrying protein.



Healthy kidneys produce a hormone called erythropoietin, or EPO, which stimulates the bone marrow to make red blood cells needed to carry oxygen (O_2) throughout the body.



Diseased kidneys don't make enough EPO, and bone marrow then makes fewer red blood cells.

Laboratory Tests

A complete blood count (CBC), a laboratory test performed on a sample of your blood, includes a determination of your hematocrit (Hct), the percentage of the blood that consists of red blood cells. The CBC also measures the amount of

National Institute of Diabetes and Digestive and Kidney Diseases
NATIONAL INSTITUTES OF HEALTH

Hgb in your blood. The range of normal Hct and Hgb in women who menstruate is slightly lower than for healthy men or healthy postmenopausal women. The Hgb is usually about one-third the value of the Hct.

When Anemia Begins

Anemia may begin to develop in the early stages of kidney disease, when you still have 20 percent to 50 percent of your normal kidney function. This partial loss of kidney function is often called chronic renal insufficiency. Anemia tends to worsen as kidney disease progresses. End-stage kidney failure, the point at which dialysis or kidney transplantation becomes necessary, doesn't occur until you have only about 10 percent of your kidney function remaining. Nearly everyone with end-stage kidney failure has anemia.

Diagnosis

If you have lost at least half of normal kidney function (serum creatinine greater than 2 mg/dL) and have a low Hct, the most likely cause of anemia is decreased EPO production. The National Kidney Foundation's Dialysis Outcomes Quality Initiative (DOQI) recommends that doctors begin a detailed evaluation of anemia in men and postmenopausal women on dialysis when the Hct value falls below 37 percent. For women of childbearing age, evaluation should begin when the Hct falls below 33 percent. The evaluation will include tests for iron deficiency and blood loss in the stool to be certain there are no other reasons for the anemia.

Treatment

EPO

If no other cause for EPO deficiency is found, it can be treated with a genetically engineered form of the hormone, which is usually injected under the skin two or three times a week.

When to Evaluate Dialysis Patients for Anemia

	Hematocrit (Hct)	Hemoglobin (Hgb)
Women who menstruate	less than 33%	less than 11 g/dL
All men and postmenopausal women	less than 37%	less than 12 g/dL

Source: The National Kidney Foundation's Dialysis Outcomes Quality Initiative.

Hemodialysis patients who can't tolerate EPO shots may receive the hormone intravenously during treatment, but this method requires a larger, more expensive dose and may not be as effective. DOQI recommends that patients treated with EPO therapy should achieve a target Hgb of 11 to 12 g/dL.

Iron

Many people with kidney disease need both EPO and iron supplements to raise their Hct to a satisfactory level. If your iron levels are too low, then EPO won't help and you'll continue to experience the effects of anemia. You may be able to take an iron pill, but many studies show that iron pills don't work as well in people with kidney failure as iron given intravenously. Iron is injected directly into an arm or into the tube that returns blood to your body during hemodialysis.

A nurse or doctor will give you a test dose because a very small number of people (less than 1 percent) have a bad reaction to iron injections. If you begin to wheeze or have trouble breathing, your health care provider can administer epinephrine or corticosteroids to counter the reaction. Even though the risk is small, you'll be asked to sign a form stating that you understand the possible reaction and

that you agree to have the treatment. Talk with your health care provider if you have any questions.

In addition to measuring your Hct and Hgb, your tests will also include two measurements to show whether you have enough iron.

- Your ferritin level indicates the amount of iron stored in your body. According to DOQI guidelines, your ferritin score should be no less than 100 micrograms per liter (mcg/L) and no more than 800 mcg/L.
- TSAT stands for transferrin saturation, a score that indicates how much iron is available to make red blood cells. DOQI guidelines call for a TSAT score between 20 percent and 50 percent.

Other Causes of Anemia

In addition to EPO and iron, a few people may also need vitamin B_{12} and folic acid supplements.

If EPO, iron, vitamin B_{12}, and folic acid all fail, your doctor should look for other causes such as sickle cell disease or an inflammatory problem. At one time, aluminum poisoning contributed to anemia in people with kidney failure because many phosphate binders used for treating bone disease caused by kidney failure were antacids that contained aluminum. But aluminum-free alternatives are now widely available. Be sure your phosphate binder and your other drugs are free of aluminum.

Anemia keeps many people with kidney disease from feeling their best. But EPO treatments help most patients raise their Hgb, feel better, live longer, and have more energy.

Hope Through Research

The National Institute of Diabetes and Digestive and Kidney Diseases (NIDDK), through its Division of Kidney, Urologic, and Hematologic Diseases, supports several programs and studies devoted to improving treatment for patients with progressive kidney disease and end-stage kidney failure (sometimes called end-stage renal disease, or ESRD), including patients on hemodialysis:

- **The End-Stage Renal Disease Program.** This program promotes research to reduce medical problems from bone, blood, nervous system, metabolic, gastrointestinal, cardiovascular, and endocrine abnormalities in end-stage kidney failure and to improve the effectiveness of dialysis and transplantation. The research focuses on reuse of hemodialysis membranes and on using alternative dialyzer sterilization methods; on devising more efficient, biocompatible membranes; on refining high-flux hemodialysis; and on developing criteria for dialysis adequacy. The program also seeks to increase kidney graft and patient survival and to maximize quality of life.
- **The HEMO Study.** This multicenter clinical trial is testing whether a higher hemodialysis dose and/or high-flux membranes will reduce patient mortality (death) and morbidity (medical problems).
- **The U.S. Renal Data System (USRDS).** This national data system collects, analyzes, and distributes information about the use of dialysis and transplantation to treat kidney failure in the United States. The USRDS is funded directly by NIDDK in conjunction with the Health Care Financing Administration. The USRDS publishes an *Annual Data Report*, which characterizes the total population of people being treated for kidney failure; reports on incidence, prevalence, mortality rates, and trends over time; and develops data on the effects of various treatment modalities. The report also helps identify problems and opportunities for more focused special studies of renal research issues.

- **The Hemodialysis Vascular Access Clinical Trials Consortium** will conduct a series of multicenter, randomized, placebo-controlled clinical trials of drug therapies to reduce the failure and complication rate of arteriovenous grafts and fistulas in hemodialysis. Recently developed antithrombotic agents and drugs to inhibit cytokines may be evaluated in these large clinical trials.

For More Information

For more information, contact the following organizations:

American Association of Kidney Patients
100 South Ashley Drive
Suite 280
Tampa, FL 33602
Phone: 1–800–749–2257 or (813) 223–7099
Fax: (813) 223–0001
Email: AAKPnat@aol.com
Internet: www.aakp.org

American Kidney Fund
6110 Executive Boulevard
Rockville, MD 20852
Phone: 1–800–638–8299
Fax: (301) 881–0898
Email: helpline@akfinc.org
Internet: www.akfinc.org

National Kidney Foundation
30 East 33rd Street
New York, NY 10016
Phone: 1–800–622–9010
Fax: (212) 889–2210
Email: info@kidney.org
Internet: www.kidney.org

National Kidney and Urologic Diseases Information Clearinghouse

3 Information Way
Bethesda, MD 20892–3580
Phone: 1–800–891–5390 or (301) 654–4415
Fax: (301) 907–8906
Email: nkudic@info.niddk.nih.gov

The National Kidney and Urologic Diseases Information Clearinghouse (NKUDIC) is a service of the National Institute of Diabetes and Digestive and Kidney Diseases (NIDDK). NIDDK is part of the National Institutes of Health under the U.S. Department of Health and Human Services. Established in 1987, the clearinghouse provides information about diseases of the kidneys and urologic system to people with kidney and urologic disorders and to their families, health care professionals, and the public. NKUDIC answers inquiries; develops and distributes publications; and works closely with professional and patient organizations and Government agencies to coordinate resources about kidney and urologic diseases.

Publications produced by the clearinghouse are carefully reviewed by both NIDDK scientists and outside experts. This fact sheet was also reviewed by Dr. John C. Stivelman, Emory University School of Medicine.

This fact sheet is also available under "Health Information" at *www.niddk.nih.gov* on the Internet.

U.S. DEPARTMENT OF HEALTH ANDHUMAN SERVICES
National Institutes of Health

NIH Publication No. 01–4619
April 2001